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ABSTRACT

To learn when children would be able to evaluate and revise texts that presented significant comprehension problems, and to investigate the relationship between general reading skill and comprehension monitoring and revision skills, a study administered revision tests to 65 fourth grade and 38 sixth grade students from a rural New England school district. Students were classified as good, average, or poor readers on the basis of their reading comprehension scores on the Gates-MacGinitie test. Students participated in three revision tasks: (1) story writing and revision; (2) revision of a peer story; and (3) a comprehension monitoring and revision interview, where students were asked to evaluate and revise eight experimental texts containing different comprehension problems. Results indicated that although students took their role as "editors" seriously and made suggestions for improving the texts, they had difficulty seeing that the sentences were inconsistent or that the information necessary for complete comprehension was not actually provided in the texts. Findings showed a strong relationship between students' reading ability and their comprehension monitoring and revision performance. Also, the performance of good readers improved more with age than that of average and poor readers. Finally, a comparison of students' performance on the different types of text problems showed that they were able to use several revision strategies, such as addition and deletion, to improve texts. (Three tables of data and four figures are appended.) (MM)

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Elementary school children's ability to evaluate and revise the communicative quality of written texts

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Running head: Revision

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Abstract

The goal of this study was to investigate children's ability to evaluate and revise texts that presented significant comprehension problems when the information was integrated and compared across individual well-formed sentences. Fourth and sixth graders were first asked to evaluate three types of problematic texts and then to suggest changes to make the texts easier to understand. In addition, children participated in two revision tasks in their classrooms. The comprehension monitoring and revision performance of good, average and poor readers was also compared. The results showed that older children and better readers detected more of the text problems and therefore were more likely to revise them. They also made more frequent revisions in the classroom. However, once younger children and less-skilled readers had detected a text problem they were as likely as older children and better readers to revise the text adequately. The results suggest that while poor comprehension monitoring skills limit children's revision performance, children can make substantive revisions once they have detected the text problems.

Elementary school children's ability to evaluate and revise the communicative quality of written texts

There have been many studies of elementary school children's developing comprehension monitoring skills (see Dickson, 1981). Baker and Brown (1984) have suggested that the process of comprehension monitoring involves two components: first, assessing one's current state of comprehension and second, taking corrective action once a comprehension problem has been detected. Most research has focused on the first component: children's developing ability to monitor their own or another person's comprehension (Dickson, 1981; Flavell, Speer, Green & August, 1981; Markman, 1977, 1979). These studies have found that elementary school children tend to overestimate how well they or another person understood material that was actually contradictory, incomplete or ambiguous.

Researchers have also begun to assess children's skill in the second component of comprehension monitoring: their ability to take corrective action once comprehension problems have been detected (Baker & Brown, 1984). One important type of corrective action is to revise the message to provide clarifying information and resolve the communication problem. To revise the message the child must first evaluate its communicative quality and decide if it is inadequate. If a problem is detected, the child must locate the exact words of the message that are unclear and produce a new version of the message to resolve the problem (Beal, 1987). Thus, revision of the message requires the child to maintain a clear distinction between his or her intended meaning and the "very words" or literal meaning of the message itself (Olson & Hildyard, 1983; Robinson, Goelman & Olson, 1983). Without this distinction, the child might realize that the message was unclear and that a communication problem exists, but might then be unable to locate exactly the source of the problem in the words of the message or to change the words to represent more accurately the intended meaning.

There have been several studies of children's ability to revise simple messages in referential communication tasks. Peterson, Danner and Flavell (1972) found that children did not reformulate their messages to help a confused listener select the right referent until the listener explicitly directed them to "say something else" about the referent. However, it was possible that the children in this study did not realize that their own messages were unclear and needed to be revised. Several recent studies have found that children are able to revise messages once they have detected the message problems. Bonitatibus (in press) found that children could indicate what a speaker should have said to describe a particular referent, after they had indicated that the speaker's orally-presented message was ambiguous. Beal (1987) also found that children could revise simple written messages after they had detected the message problems. These results imply that poor message evaluation skills limit children's ability to revise messages, since once they realize that the message is unclear they have some ability to compare the literal meaning of the message to the referents, to

notice discrepancies or ambiguities, and to reformulate the words of the message to resolve the comprehension problem. However, these studies provide only limited information about children's developing revision skills, for several reasons. First, the revisions were fairly simple: only one or two words needed to be changed to improve the messages. Second, children only revised the messages when the speaker's intended goal was known and provided guidance about the type of repair that was necessary. In addition, in these studies the referents were physically present, so a comparison of the words of the message with the referents would have helped children notice the discrepancies and ambiguities. Relatively little is known about children's ability to revise more complex messages that do not describe concrete objects, their ability to improve the communicative quality of a message when the speaker's intended meaning is not known directly, or their ability to detect and revise different types of text problems.

The goal of this study was to learn when children would be able to evaluate and revise texts that presented significant comprehension problems when different sentences in the texts were compared. Successful revision of such messages would require the child to analyze the exact words of the text, locate the specific sentences or parts of the text that were in conflict with one another, and then change the existing sentences or generate new text to provide the missing information. Markman (1981) has suggested that children have difficulty in monitoring their comprehension of such texts because they process the information one sentence at a time and do not compare and integrate the information across sentences. If children do not process the information actively they may certainly fail to detect the discrepancies between sentences, overlook comprehension problems and therefore fail to revise the texts. Several studies have found that children rarely make revisions that improve the comprehensibility of their work (Bereiter & Scardamalia, 1986; Markman, 1979; National Assessment of Educational Progress, 1986). However, it is not yet clear whether children fail to revise because they have poor message evaluation skills or because they have inadequate text repair skills. Children might realize that a text is unclear but then be unable to revise it successfully, for several reasons. First, they might find it difficult to focus on the literal meaning of the text itself in order to locate and identify exactly what is wrong. Second, they might find it difficult to provide new information that is not specified by the text itself. Such information might need to be generated through inferences or assumptions about the author's probable intention, or imported through real world knowledge. Finally, they might be unable to consider both whether the new material resolves the target problem and whether it is also consistent with the existing text as a whole. Therefore, successful detection of a text problem may not necessarily be followed by an appropriate revision.

In this study, fourth and sixth grade children were asked to evaluate problematic texts and to revise the texts to make them easier to understand. Three types of problematic texts were used to compare children's ability to detect several types of text problems

and to investigate their ability to use different types of revision strategies to resolve the problems. First, children were asked to evaluate and revise the communicative quality of stories with missing information (August, Flavell & Clift, 1984). These stories required the addition of new information to explain how the problem described in the text was solved. Second, children evaluated and revised stories that contained anomalous sentences, which required that the anomalous sentence be rewritten to be consistent with the other sentences or deleted entirely (Capelli & Markman, 1985). Bereiter and Scardamalia (1986) have observed that children are particularly reluctant to use deletion as a revision strategy. Third, children were also asked to evaluate and revise informative paragraphs that contained contradictory sentences (Capelli & Markman, 1985; Markman, 1979). These paragraphs required specific pieces of factual knowledge to revise successfully. However, Markman (1979) had found that when the experimenter pointed out the contradictions about one quarter of the children made assumptions or guesses to explain the inconsistencies. It was possible that children might be able to use such inferences to provide a clearer explanation of the information if they were asked to revise as well as evaluate the communicative quality of the paragraphs.

Another goal of the study was to investigate the relationship between general reading skill and comprehension monitoring and revision skills (Baker & Brown, 1984). Several studies have found that good readers were better able to monitor the communicative quality of texts than were less skilled readers of the same age, suggesting that relatively skilled readers might also be better able to locate and repair text problems (August, Flavell & Clift, 1984; Baker & Brown, 1984; Garner, 1980, 1981). However, good readers may also rely on inferential strategies and top-down "filling in" of problematic sections of text and might therefore overlook the need to revise some text problems. Although there is evidence that good readers tend to revise more in the classroom, most of their revisions consist of spelling corrections and minor editing (National Assessment of Educational Progress, 1986). It is not yet clear whether good and poor readers would also differ in their ability to revise significant text problems that depend on the comparison and integration of information across sentences.

Finally, a secondary question addressed in the study was whether children's performance on comprehension monitoring and revision tasks might be related to the frequency and type of revisions that they would make on classroom writing tasks. In addition to the comprehension monitoring and revision task, children also participated in two revision tasks conducted in the classroom. They revised a story originally written by another child that contained spontaneously produced errors ranging from minor misspellings to an unresolved obstacle that made the story difficult to understand. They also revised a story that they had written themselves on the previous day.

Method

Subjects. Sixty-five fourth grade (M = 10 years 6 months) and 38 sixth grade (M = 13

years 3 months) children from a rural New England school district participated in the study. Children came from predominately middle- to lower-middle-class homes. Letters were sent to the children's parents describing the study and requesting parental consent for the children's participation and for access by the researchers to the children's reading test scores which were maintained by school personnel. About 90% of the parents gave their permission. Children were classified as good, average or poor readers on the basis of their reading comprehension scores on the Gates-MacGinitie test. Children who read more than two grade levels above their current grade were considered good readers. There were 21 fourth grade good readers and 12 sixth grade good readers. Children who read at grade level or one grade above were considered average readers. There were 24 fourth grade average readers and 12 sixth grade average readers. Children who read one or more grade levels below their current grade were considered poor readers. There were 20 fourth grade poor readers and 14 sixth grade poor readers. The M grade equivalents for good, average and poor readers were 7.1, 4.6, and 3.2 for fourth graders, and 9.8, 6.7, and 5.0 for sixth graders, respectively.

Materials. For the comprehension monitoring and revision test each child received a booklet of eight texts to be evaluated and revised. One text was printed in large font on each page, with sufficient margin space to enter corrections. Six of the eight texts contained comprehension problems. Two stories had missing information so that it was not clear how the problem in the story had been solved (August, Flavell & Clift, 1984). Two stories contained anomalous sentences that were inconsistent with the other sentences in the stories (Capelli & Markman, 1985). Two additional texts were informative paragraphs that contained contradictory sentences (Markman, 1979; Capelli & Markman, 1985). The remaining two texts were stories that did not present any obvious comprehension problems. The texts were assembled into the booklet in two randomly determined orders. The informative paragraphs were presented after the stories in the booklet because they were predicted to be particularly difficult to revise and might have discouraged children from suggesting changes if encountered early in the interview. Examples of the problematic texts are shown in Figure 1.

For the classroom writing tasks, children wrote in pencil on ordinary lined school paper. They were given red ballpoint pens to make corrections to their work, as described below. Two stories previously written on a computer by third grade children in another school district were used for the peer story revision activities. The stories were chosen because they contained several types of spontaneously produced errors, including spelling and punctuation mistakes, missing words, a sentence with incorrect syntax, and descriptions of events that were left unresolved and made it hard for the reader to understand the story. Half of the subjects received a copy of one story to revise, while the other subjects revised the second story.

Procedure. Children participated in three revision tasks: story writing and revision,

revision of a peer story, and the comprehension monitoring and revision interview. The story writing and revision activities were conducted in the classroom, while children were tested individually on the comprehension monitoring task. The interviewers did not know the children's reading levels while the data were being collected.

Two adult female experimenters came to the classrooms and were introduced by the teacher as people who would work with the children on writing and revision. Each child then met individually with one of the experimenters in the school office or an empty classroom. In this session, the child was presented with eight texts to be evaluated and revised. The experimenter explained that she and her partner had been developing some written materials for children and that they wanted the subject to listen to them and suggest ways to make them easier to understand (Markman, l979). She explained that the child could help her "fix up" the texts and by way of example changed a word on the first page of the booklet. (This also showed the child that making corrections to the typed text was acceptable.) She warned the child that other children had found the stories and paragraphs difficult to understand and emphasized that she really wanted the child's help in locating and clarifying parts of the texts that were unclear.

The experimenter then read a story aloud to the child. She pointed to each line and read slowly, encouraging the child to follow the words (Bonitatibus & Flavell, 1985). When the story had been presented to the child, she first asked if the child thought that it was clear or if there were parts that were difficult to understand. Second, she asked the child if he or she could suggest any changes to the text that would make the story or paragraph easier to understand. The child dictated his or her changes to the experimenter, who used the red pen to make the corrections or add new material to the story. The remaining texts were then presented. Before reading the first paragraph the experimenter mentioned that the last two texts in the booklet were paragraphs that contained information about a particular topic, and stressed that other children had found that the paragraphs were difficult to understand.

The classroom revision tasks followed the comprehension monitoring test within a week. The experimenter came to the classroom and told the children that they would be writing a story that morning on a topic of their choice. She encouraged them to select a topic that could be completed in the 30 minute period. She asked for story ideas and discussed possible topics for five minutes to help children generate ideas. Then the children were left to write for 30 minutes. The experimenter and classroom teacher provided information about spelling when requested. The stories were collected and photocopied. The next morning, the stories were returned to the children. The experimenter explained that she wanted the children to reread their stories and revise them. She reminded the children that she had asked them for help in revising the written materials in the previous week, emphasized that making changes was a normal and important part of writing, and reminded the children that they could add

new information, cross out parts, rewrite sections or otherwise change their stories to make them easier to understand. Each child was given a red pen to use for making corrections. When children had completed revising their own story they were given the peer story to revise in the same way. The classroom revision session lasted 20-30 minutes.

Results

Comprehension monitoring. The number of target message problems detected for the missing information, anomalous sentence and contradictory texts was summed for each child. These scores were analyzed in a 2 (Grade) x 3 (Reading Level) x 3 (Text Type) analysis of variance, with Text Type as a within subjects factor. Mean scores are shown in Table 1. The results showed an effect of Grade, $F(1,98) = 33.62$, $p < .001$, with sixth graders detecting a mean of 3.71 of the six message problems compared to a mean of 1.56 for the fourth graders. There was also an effect of Reading Level, $F(2,98) = 11.82$, $p < .01$. Newman-Keuls post hoc comparisons ($a < .05$) showed that good readers detected more message problems ($M = 3.61$) than average ($M = 2.73$) or poor readers ($M = 1.58$), who were also significantly different from each other. The interaction between Grade and Reading Level reached only a marginal level of significance, $F(2,98) = 2.39$, $p < .09$. Figure 2 shows that the effect of grade was greatest for better readers, while poor readers in both grades performed similarly.

The results also showed an effect of Text Type, $F(2,196) = 4.41$, $p < .05$. The mean number of missing information problems detected ($M = .97$, of two possible) was signficantly different from the mean number of anomalous sentences detected ($M = .72$) but not from the mean for the contradictory sentence problems ($M = .86$). The Grade x Task Type interaction reached a marginal level of significance, $F(2,196) = 2.56$, $p < .08$, suggesting that the difference in problem detection performance between the fourth and sixth graders was most apparent with the contradictory sentence texts. The triple interaction between Grade, Reading Level and Task Type was significant, $F(4,196) = 2.94$, $p < .05$. It appeared that the comprehension monitoring performance of the fourth graders was relatively consistent compared to the sixth graders, whose performance was more affected by their level of reading skill or the particular type of message problem they were asked to evaluate.

Revisions of target text problems. Revisions were coded as adequate or inadequate by two independent judges, with an overall agreement of 87%. Scores were then figured for the number of message problems of each type that had been correctly evaluated and then revised adequately by each child. (These scores included several instances where a child initially said the text was clear but when asked to revise he or she then correctly identified the problem and repaired it.) These scores were analyzed in a 2 (Grade) x 3 (Reading Level) x 3 (Task Type) analysis of variance, with Task Type as a within subjects factor. Since the revisions depended on earlier problem detection the overall pattern of results is similar to that for comprehension monitoring, although the mean scores (shown in Table 2) are generally lower since children did not always

revise a problem once they had detected it. There was an effect of Grade, $F(1,98) = 17.69$, $p < .001$. Sixth graders revised an average of 2.39 text problems, while fourth graders revised an average of 1.12 problems. There was also an effect of Reading Level, $F(2,98) = 12.26$, $p < .001$. Good readers revised significantly more ($M = 2.58$) of the message problems than the average readers ($M = 1.76$) whose performance was in turn significantly better than that of the poor readers ($M = 0.84$).

There was also a significant interaction between Grade and Reading Level, $F(2,98) = 5.68$, $p < .01$. Unplanned contrasts ($a < .05$) showed that good and average readers in sixth grade revised significantly more of the text problems than their respective counterparts in fourth grade, but that sixth grade poor readers were not significantly different from fourth grade poor readers. Mean total revision scores are shown in Figure 3. Finally, there was a significant effect of Task Type, $F(2,196) = 16.97$, $p < .001$. Newman-Keuls comparisions ($a < .05$) showed that revision scores were higher for the missing information ($M = .78$, of two possible) and anomalous sentence texts ($M = .65$) than for the contradictory sentence texts ($M = .32$).

Figure 4 shows examples of typical revisions to the texts. Changes generally involved adding a sentence or two to the missing information stories, and crossing out or rewriting the target sentence in the anomalous sentence stories. Contradictory sentence paragraphs were more difficult to repair because real world knowledge was required. Children who revised these paragraphs successfully very frequently reported the source of their knowledge, such as books on the topic or recent trips to a science museum or aquarium.

Unattempted and unsuccessful revisions. Mean scores were also computed for the number of text problems correctly identified but then *not* revised by each child. Mean scores are shown in Table 3 along with scores for successful revisions and text problems not detected, for comparison. Although the sixth graders revised more of the problematic texts, this was due to their superior ability to notice the text problems in their first place, not to an increased skill in generating a repair to solve the text problem. Younger children revised as many (72%) of the text problems that they had detected as did the older children (65%). In addition, the patterns of revision failure across the three types of text problems were similar for fourth and sixth graders. Considering only the texts that they had already correctly evaluated, fourth graders could not revise 38% of the missing information stories, 12% of the anomalous sentence stories, and 50% of the contradictory sentence paragraphs. The sixth graders could not revise 29% of the missing information stories, 9% of the anomalous sentence stories and 62% of the contradictory paragraphs that they had correctly evaluated as problematic.

Attempted but unsuccessful revisions were surprisingly rare; there were only nine cases where a child identified a text problem but then dictated a solution that did not resolve it. Of course, it was possible that children might have avoided mentioning the

text problems to begin with if they knew they would not be able to think of an adequate repair. However, as described above, many children did identify text problems and then said they could not revise them, suggesting that concern about the subsequent revision question was not a major obstacle for them. The few cases of unsuccessful revision involved text changes that resolved the problem but in a way that was inconsistent with other propositions in the text. For example, one child revised the "Kate and the train" missing information story (Figure 1) by deleting the sentences where Kate falls down and hurts her leg. This revision removed the impediment to Kate's reaching the bridge successfully but created the new problem of why she would be still be worried about who would stop the train in time.

Other revisions. In addition to revising the target text problems, children also suggested revisions to other parts of the texts. Table 3 shows the mean number of additional revisions made by each child. (In contrast to the target problems, there was no maximum number of "other" revisions that could be made.) These revisions generally involved word substitutions (e.g., "lantern" for "flashlight"), adding details (e.g.,"She tripped *over a stick* and fell down hard"), and inserting "and" to join two sentences into one. The "other" revision data indicate first, that children were comfortable with the task and quite willing to suggest changes to the texts. Second, they again suggest that development in revision skill consists of an increased ability to identify the particular changes that will improve the comprehensibility of the text, rather than an increase in the overall frequency of changes. As shown in Table 3, older children made more of these "other" revisions, but they also revised more of the target text problems as well. In addition, the sixth grade poor readers actually made as many revisions (average total revisions = 7.20) to the texts as did the good readers (average total revisions = 7.58) but their changes were less likely to improve the communicative quality of the text.

Classroom revision tasks. Revisions made by each child to his or her own story were counted and coded according to Bridwell's (1980) system. This system classifies revisions into one of six categories, from editing changes (spelling, capitalization, punctuation, etc.) through single word, phrase, clause, sentence and multiple-sentence changes. Two independent judges coded the story revisions, with an overall agreement of 94%. The older children wrote almost twice as much as the younger children in the 30 minute period, so a revision rate score was computed for each child that indicated the number of changes made to the text per 100 words. These scores were analyzed in a 2 (Grade) x 3 (Reading Level) analysis of variance. The results showed an effect of Grade, $F(1,92) = 15.06$, $p < .001$, with fourth graders having a *higher* revision rate ($M = 5.88$) than the sixth graders ($M = 2.55$). However, the *types* of changes made suggested that this resulted from the fact that the sixth graders produced better first drafts to begin with and thus required fewer mechanical revisions later. Eighty percent of the fourth graders' revisions and 83% of the sixth graders' revisions were classified as minor editing or single word changes (Bridwell, 1980).

Very few of the children's changes affected the meaning, organization or comprehensibility of their work. The analysis of the revision rate scores also showed an effect of Reading Level, with good readers making the most changes to their work (M = 5.22 revisions per 100 words) compared to average (M = 3.82) and poor readers (M = 3.60). There was no interaction.

Revision rate scores were also computed for the number of changes per 100 words made by each child to the peer story. A 2 (Grade) x 3 (Reading Level) analysis of variance showed sixth graders made more revisions (M = 11.11) to the peer story than the fourth graders (M = 7.20), $F(1,97) = 17.35$, $p < .001$. Good readers also revised more (M = 12.35) than average (M = 8.53) or poor readers (M = 6.59), $F(2,97) = 13.05$, $p < .01$. The interaction between Grade and Reading Level reached only a marginal level of significance, $F(2,97) = 2.51$, $p < .08$. Sixth grade good and average readers revised more frequently than their fourth grade counterparts, but sixth grade poor readers revised at about the same rate as fourth grade poor readers. When the revisions were classified according to Bridwell's (1980) system, 79% of the fourth grade revisions and 81% of the sixth grade revisions consisted of minor editing and single word alterations.

Finally, Pearson product moment correlation coefficients were calculated for scores on the three revision tasks. (Complete sets of scores were unavailable for several subjects.) The results showed that there was a significant correlation between performance on the booklet revision task and the peer revision task, $r = .35$, $t(88) = 3.50$, $p < .01$. Children who identified and revised more problems in the prepared texts also made more changes to the other child's story. However, there was no significant association between performance on the booklet revision task and revisions to the children's own story, or between revisions made to the children's own story and the peer story, since the pattern of older children making more revisions on the booklet and peer revision task was not found on the self-revision task.

General Discussion

In this study children were asked to evaluate the communicative quality of three types of problematic texts and to revise the text problems to make them easier to understand. Previous research had shown that elementary school children often overlooked problems in these types of texts and reported incorrectly that they had understood the texts (August, Flavell & Clift, 1984; Capelli & Markman, 1985; Markman, 1979). Similarly, the children in this study also failed to detect many of the text problems, particularly the younger children. Although they seemed to take their role as "editors" seriously and in fact made many suggestions for improving the texts, they had difficulty seeing that the sentences were inconsistent or that the information necessary for complete comprehension was not actually provided in the texts.

The results from this study extend earlier research on children's ability to revise problematic messages. Beal (1987) and Bonitatibus (in press) had found that first

through third grade children could make one and two word revisions to messages in referential communication tasks when they knew what the speaker had intended. In this study the text problems were more difficult to detect, because each sentence was perfectly comprehensible and the material only appeared to be unclear when the sentences were compared and considered together. The revisions were also more difficult to make: to revise these texts children had to identify exactly which sentences were problematic, generate new information without knowing what the original author had in intended, and check that the new information did not conflict with other sentences in the text. The results showed that fourth graders could perform this text analysis and generation task as well as the sixth graders. The increase in revision scores from fourth to sixth grade was due almost entirely to the older children's superior comprehension monitoring ability; once they had seen that a text was not clear children in both grades were equally able to dictate an adequate revision to improve the comprehensibility of the text. Some of the older children's revisions may well have been superior to those of the fourth graders in terms of their interest for the reader or their complexity, but the younger children were as able to produce repairs that adequately eliminated the inconsistencies or supplied the missing information.

The finding that children can repair text problems might in turn increase our understanding of what it means to monitor one's comprehension. Children who both evaluated and revised a text seemed to have a mental representation of the text as a whole and could use this representation as a source of inferences or new material that could be used to repair the text itself. In addition, they also could distinguish this representation -- their understanding of the text -- from the literal meaning or "very words" of the text, and could compare their understanding of the text with the words to locate discrepancies. Previous research had also found that first through third grade children could compare the words of the speaker's message to concrete referents and could locate discrepancies and ambiguities between the words and the objects. This ability to compare one's mental representation of the material with its source -- a message or text -- may be the important step that leads children to realize clearly that they have not understood what the speaker or author meant. Several studies have found that children sometimes show nonverbal signs that they have not understood (Flavell et al., 1981; Patterson, Cosgrove & O'Brien, 1980). They may appear confused or uncertain when they are first presented with a problematic message or text, but then report that the message was clear. It may be that on these occasions children sense that they are having trouble with the processing required to produce a coherent mental representation of the speaker's meaning, but they do not compare their mental representation with the words of the message to identify the source of the problem. Children's ability to recognize and report that they have not understood something may therefore depend on their ability to distinguish clearly between what they think the speaker or author might have meant, and the words produced by the speaker or author (Bonitatibus, in press; Olson & Hildyard, 1983).

The results of this study also showed a strong relationship between children's reading ability and their comprehension monitoring and revision performance, even though the children's reading ability was assessed by standardized test scores rather than by more accurate individual testing. The superior performance of better readers was apparent on all the message evaluation and revision measures, including the classroom tasks: Children who could comprehend more of what they read were also better able to detect that what they read did not make sense and to suggest changes to make the text easier to understand. They also tended to make more frequent changes to their own story and the peer story on the classroom revision tasks. Markman (1981) argued that comprehension monitoring failures result because children do not process the information in the text in an active way that involves the comparison and integration of individual propositions into a mental representation of the text as a whole. Skilled readers seem better able to perform this kind of active processing, which supports both better comprehension and comprehension monitoring. However, in this study the less skilled readers were also able to revise the texts once they had detected the comprehension problems, again suggesting that children's performance on the revision task was limited by their message evaluation skills, not their ability to locate and repair the text problems.

The performance of the good readers also improved more with age than that of the average and poor readers. Although the interactions between age and children's reading level reached only marginal levels of significance in this study, the pattern was consistent across both comprehension monitoring and revision measures. An important question for future research is why the poor readers improved so little with age on these tasks: the sixth grade poor readers performed almost as poorly as their fourth grade counterparts. Decoding problems do contribute to poor readers' difficulty in understanding written materials, so it is possible that the sixth grade poor readers found it difficult to reread the stories to locate and revise comprehension problems. On the other hand, the stories used in this study were written at the third grade level and were read aloud by the experimenter. In addition, these children did make many revisions to the texts, suggesting that they were attending to the exact words on the page. While these data do not provide a direct answer to this question, they do suggest that children who do not develop adequate comprehension skills may also not be able to assess accurately their own level of comprehension or to locate the source of the problem in the text (August, Flavell & Clift, 1984; Baker & Brown, 1984; Garner, 1980, 1981).

A comparison of children's performance on the different types of text problems showed that they were able to use several revision strategies to improve the texts. Children used both addition and deletion strategies to repair the missing information and anomalous sentence stories. While Bereiter and Scardamalia (1986) had found that children did not like to delete material while revising their own written work, the children in this study usually suggested crossing out the anomalous sentence in order to make

the story easier to understand. Of course, children may well have felt less personal attachment or commitment to the prepared texts used in this study. However, it seems that they were capable of imagining how the text would read when part of it had been deleted. One limitation of this study is that the revisions were only judged to be either adequate or inadequate. As mentioned above, some of the repairs may well have involved more consideration of the reader's information needs or more integration of the repair with the existing text than others. For example, suggesting that Kate should wave her flashlight to stop the train might be considered a more interesting or advanced revision than suggesting that she should shout to stop the train, because it integrates the resolution of the problem with her earlier action of grabbing the flashlight as she left the house. Future research should consider children's ability to produce or select revisions that can be evaluated in terms of their quality as well as adequacy.

The revision data also point to the importance of knowledge in revision. While children found the contradictory sentence and missing information problems significantly easier to detect than the anomalous sentences, they found the contradictory paragraphs the most difficult to revise. Children could use inferences and assumptions to generate plausible ideas about what might have happened in the stories but specific factual knowledge was necessary to repair the paragraphs. Some children clearly recognized this (some actually seemed quite frustrated by it) and could define in fairly specific detail what sort of information would be required. For example, one sixth grade boy with considerable experience in hunting mused, "I know deers have some sort of sensors on their legs...maybe ants have something like that...but I don't know that much about insects." However, children who speculated about the resolution of the comprehension problem were not willing to dictate a repair to the paragraphs that might not have been correct. Of course, they had originally been told that the goal of the interview was to improve the texts so that other children would understand them better, so they may have felt with some justification that their guesses would mislead other children if incorporated into the texts.

The results from this study imply that a thorough knowledge of the topic at hand is essential for some types of revision. Yet an increased familiarity with the subject may in turn increase the difficulty of evaluating the message in terms of a novice reader's information requirements. There is some evidence that children who are familiar with the speaker's intended meaning have more trouble seeing that his or her message was actually unclear (Beal & Flavell, 1984; Bonitatibus, in press; Robinson, Goelman & Olson, 1983). On the other hand, Tunmer, Nesdale and Pratt (1983) found that children were better able to detect problems in texts involving very familiar topics such as cartoons and sports (see also Whitehurst & Sonnenschein, 1985). Future research might therefore investigate children's ability to evaluate and revise texts on subjects about which they are experts or novices.

Finally, the results of this study have implications for classroom writing programs. While children were reasonably proficient in repairing the texts they did not always notice that the texts needed to be revised. This may help to explain why children's revisions in the classroom do not always produce improvements in the quality of their work, since they may not detect what parts of their texts should be changed (National Assessment of Educational Progress, 1986). Data from the classroom revision tasks and from other studies show that children focus instead on mechanical corrections and minor editing of their work rather than on substantive revisions (Bridwell, 1980; Bruce, Collins, Rubin & Gentner, 1982; Cameron, Hunt & Linton,1987). In addition, the result suggests that methods for improving revision performance should focus on the enhancement of comprehension monitoring skills. Several researchers have found that children can learn procedures for evaluating the communicative quality and comprehensibility of messages and texts (Whitehurst & Sonnenschein, 1981). Capelli and Markman (1985) taught third and sixth grade children to ask themselves questions about events in a story as they read it. Children who mastered the self-questioning procedure were more likely to detect problems in stories and essays. Similarly, Scardamalia and Bereiter (1983) found that children could learn to select and apply evaluative statements to their own work. The results from this study suggest that training in message evaluation skills might in turn help children, particularly younger children and poor readers, to revise their own written work in the classroom.

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Table 1

	Problematic Text Type:		
	Missing Information	Anomalous Sentence	Contradictory Sentences
Fourth grade			
Poor readers	0.60	0.25	0.25
Average	0.69	0.44	0.24
Good	0.80	0.66	0.76
All fourth	0.69	0.45	0.41
Sixth grade			
Poor readers	0.85	0.71	0.50
Average	1.67	0.75	1.67
Good	1.75	1.50	1.75
All sixth	1.42	0.98	1.30

Table 1: Mean comprehension monitoring scores by grade, reading level and type of text problem. Maximum score per cell is 2.

Table 2

	Problematic Text Type:		
	Missing Information	Anomalous Sentence	Contradictory Sentences
Fourth grade			
Poor readers	0.55	0.25	0.10
Average	0.48	0.36	0.12
Good	0.62	0.57	0.33
All fourth	0.55	0.39	0.18
Sixth grade			
Poor readers	0.28	0.50	0.00
Average	1.16	0.83	0.58
Good	1.58	1.41	0.83
All sixth	1.00	0.91	0.47

Table 2: Mean revision scores by grade, reading level and type of text problem. Maximum score per cell is 2.

Table 3

	Target Text Problems: Detected & Revised	Detected & Not Revised	Not Detected	Other Revisions
Fourth grade				
Poor readers	0.90	0.20	4.90	2.35
Average	0.96	0.40	4.64	3.88
Good	1.52	0.71	3.76	3.04
All fourth	1.12	0.43	4.31	3.09
Sixth grade				
Poor readers	0.78	1.42	3.78	6.42
Average	2.56	1.33	2.08	5.16
Good	3.83	1.16	1.00	3.75
All sixth	2.39	1.30	2.28	5.11

Table 3: Mean number of target text problems correctly detected and revised, detected but not revised, and not detected; and mean number of other revisions to the texts, per child.

Figure 1

Missing Information Story (August, Flavell & Clift, 1984).

Kate lived with her parents in a house by the railroad tracks. Kate's father worked for the railroad. One day a terrible storm caused a flood. The flood washed away the wooden train bridge near Kate's house. Kate knew that she would have to stop the train before it got to the bridge. She decided to run to the tracks to warn the engineer. Kate grabbed a flashlight. She ran towards the tracks. She was about five hundred yards away from the railroad tracks. Then she fell down hard. She hurt her left leg. Kate was worried. She knew that someone had to stop the train before it got to the bridge. *The train stopped safely before the bridge.** Kate was very glad that she had helped. The railroad gave her a medal for saving the train.

* Story does not explain how Kate signalled the train to stop.

Anomalous sentence story (Capelli & Markman, 1985).

Janet decided to play some records. She looked through all the songs and picked out her favorite. It was a song called "As Time Goes By." She said to herself, "I haven't played this one in a long time." She played it quietly so she would not disturb her family. *She was out of practice so it sounded funny sometimes.** Janet sang along with the music. She knew some of the words and she hummed the rest. The last verse of the song was the part she liked the best. After that song was finished she played another one.

* Sentence is inconsistent with Janet playing records.

Contradictory sentences paragraph (Markman, 1979).

There are some things that almost all ants have in common. For example, they are all amazingly strong. They can carry objects that weigh more than they do. Sometimes they go very far away from their nest to find food. They go so far away that they cannot remember how to get home. So ants have a special way to help them find their way home. Everywhere they go they put out a special chemical from their bodies. They cannot see this chemical but it has a special smell. *Another thing about ants is that they do not have a nose.** Ants never get lost.

* Paragraph does not explain how ants detect the chemical.

Figure 1: Examples of problematic texts.

Figure 4

Missing Information Story (August, Flavell & Clift, 1984).

Kate lived with her parents in a house by the railroad tracks. Kate's father worked for the railroad. One day a terrible storm caused a flood. The flood washed away the wooden train bridge near Kate's house. Kate knew that she would have to stop the train before it got to the bridge. She decided to run to the tracks to warn the engineer. Kate grabbed a flashlight. She ran towards the tracks. She was about five hundred yards away from the railroad tracks. Then she fell down hard. She hurt her left leg. Kate was worried. She knew that someone had to stop the train before it got to the bridge. * The train stopped safely before the bridge. Kate was very glad that she had helped. The railroad gave her a medal for saving the train.

* Revisions:
Add: "She hollered to the driver and he heard her and stopped the train." (Fourth grader)
Add: "She ignored her pain, tied a handkerchief to her leg and limped towards the tracks. She waved her flashlight and the engineer saw her." (Sixth grader)
Add: "She found two sticks on the ground and used them to drag herself to the tracks. She yelled to stop the train." (Sixth grader)

Anomalous sentence story (Capelli & Markman, 1985).

Janet decided to play some records. She looked through all the songs and picked out her favorite. It was a song called "As Time Goes By." She said to herself, "I haven't played this one in a long time." She played it quietly so she would not disturb her family. She was out of practice so it sounded funny sometimes.* Janet sang along with the music. She knew some of the words and she hummed the rest. The last verse of the song was the part she liked the best. After that song was finished she played another one.

* Revisions:
Cross out anomalous sentence. (Fourth grader)
Put sentence after "Janet sang along with the music." (Fourth grader)
Change sentence to "The record was out of shape [warped] so it sounded funny sometimes, because she hadn't played it for a long time." (Sixth grader)

con't.

Contradictory sentences paragraph

There are some things that almost all ants have in common. For example, they are all amazingly strong. They can carry objects that weigh more than they do. Sometimes they go very far away from their nest to find food. They go so far away that they cannot remember how to get home. So ants have a special way to help them find their way home. Everywhere they go they put out a special chemical from their bodies. They cannot see this chemical but it has a special smell. Another thing about ants is that they do not have a nose. * Ants never get lost.

* Revisions:
Add: "They smell the chemical with their feelers." (Fourth grader, holding his fingers over his forehead like antennae.)
Add: "Some insects have special organs to sense things. Ants use their antennas." (Sixth grader)

Figure 4: Examples of revisions to problematic texts.